

**ATOLL RESEARCH BULLETIN**

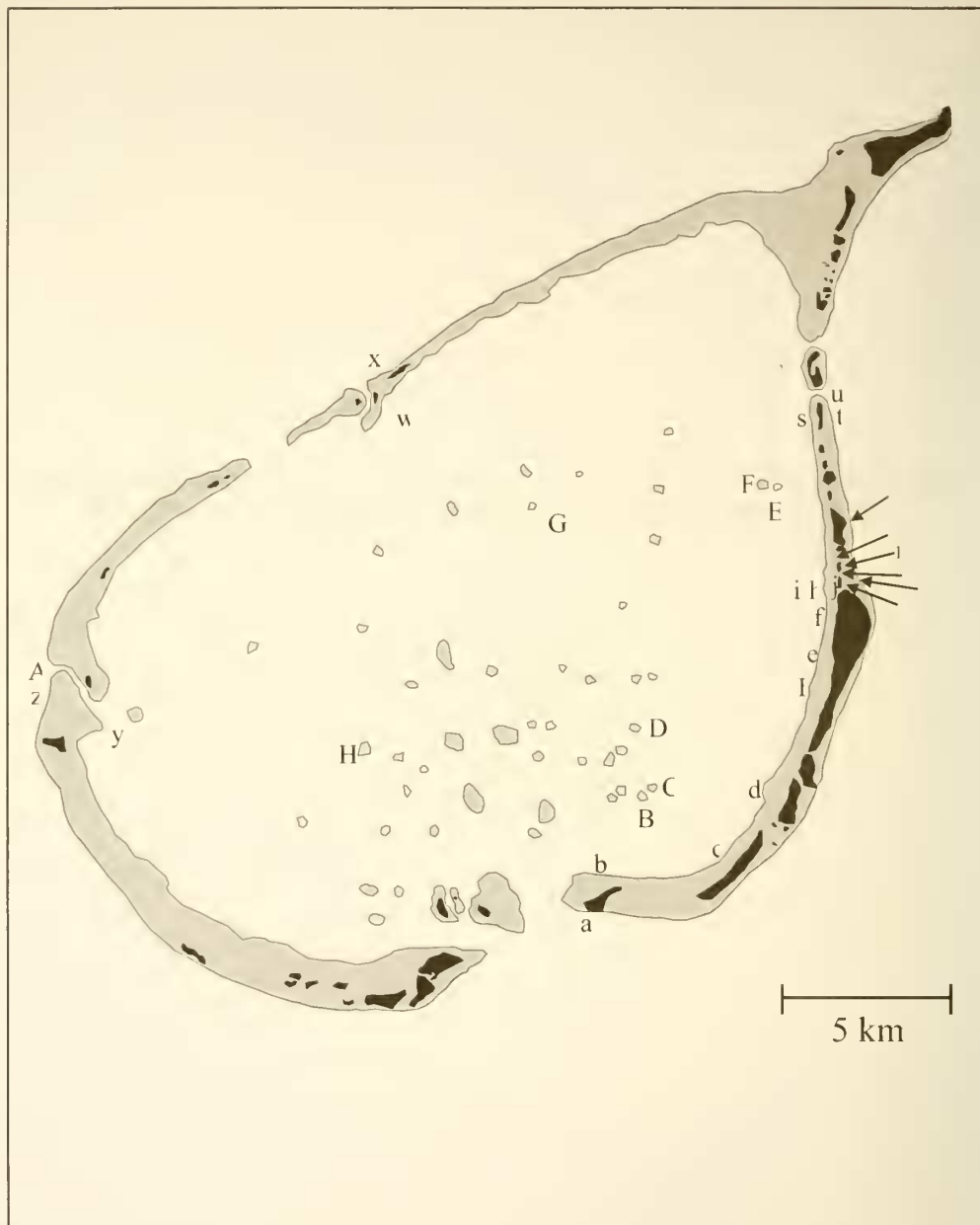
**NO. 538**

**HUMPHEAD WRASSE (*CHEILINUS UNDULATUS*) ABUNDANCE AND SIZE  
STRUCTURE AMONG CORAL REEF HABITATS IN MALDIVES**

**BY**

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**ISSUED BY  
NATIONAL MUSEUM OF NATURAL HISTORY  
SMITHSONIAN INSTITUTION  
WASHINGTON, D.C., U.S.A.  
NOVEMBER 2005**



**Figure 1.** Map of study sites within Laamu Atoll. Line surrounding shaded (lagoon and shallow coral reef) and black (island) areas indicates the reef crest. Codes reference sites listed in Table 1.

# HUMPHEAD WRASSE (*CHEILINUS UNDULATUS*) ABUNDANCE AND SIZE STRUCTURE AMONG CORAL REEF HABITATS IN MALDIVES

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ROBERT D. SLUKA<sup>1</sup>

## ABSTRACT

The abundance and size of humphead wrasse (*Cheilinus undulatus*) among 36 sites comprising five habitat types at one atoll in the Republic of Maldives were assessed through underwater visual observation. Humphead wrasse were observed more often in channel habitats than all others. The average size of sited individuals was not significantly different among the three habitats where size data was available.

## INTRODUCTION

Fishing to supply the live-fish food trade has been implicated in the demise of coral-reef fisheries for grouper and humphead wrasse (*Cheilinus undulatus*) in many areas of the Indo-Pacific (Erdmann and Pet-Soede, 1996; Johannes and Riepen, 1995; Donaldson and Sadovy, 2001; Sadovy and Vincent, 2002). Humphead wrasse, also known as the Napoleon or Maori wrasse, are one of the most highly sought after species. Little is known about the biology of humphead wrasse. This is one of the largest of all reef-dwelling teleosts, only smaller than a few grouper species (Randall et al., 1978). The largest reliably recorded specimen was 229 cm long (Randall et al., 1990). This species ranges from 0.5 - 60 m in depth and occurs from the east coast of Africa and Red Sea across the Indian Ocean to the central Pacific Ocean (Debelius, 1993; Gomon, 1984). Juvenile humphead wrasse have been observed in shallow sandy areas adjacent to coral-reef lagoons and in lagoonal staghorn coral thickets (*Acropora* spp) (Debelius, 1993; Randall, 1955; Randall et al., 1978). Adults tend to be more common offshore and deeper, especially in outer-reef slopes and channels, but can also be found in lagoons (Randall, 1955; Randall et al., 1978; Sluka, 2001). This species eats mollusks, fishes, sea urchins, crustaceans, and other invertebrates (Randall et al., 1978; Randall et al., 1990). Humphead wrasse exhibit paired spawning in small groups or larger aggregations (Donaldson, 1995).

This study was conducted to examine the large-scale distribution patterns of the humphead wrasse in Laamu Atoll, Republic of Maldives.

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## METHODS

### Habitat Description

The Republic of Maldives is a chain of coral-reef atolls stretching from about 7°N to 2°S at 73°E. The southern atolls of the Maldives, such as Laamu, are distinctly different from the northern ones including fewer channels and, consequently, larger unbroken coral-reef structures (Anderson, 1992). There is a typical zonation to most reefs progressing from inshore-to-offshore with a shallow sandy lagoon, reef flat, reef crest, and reef slope. The outside atoll-rim reef slope drops precipitously to about 30-45 m, slopes gently for about a half kilometer, then drops again to abyssal depths (Anderson et al., 1992). The inner reef slope drops steeply to about 20-30 m and then grades into a sandy bottom which occupies the inner portion of the atoll. Laamu Atoll has the deepest inner lagoon of all Maldivian atolls reaching to 73 m. A unique feature of these atolls is the circular reef rings which rise from the atoll's inner floor called faros. Many are similar in zonation with a reef flat, crest, and slope.

### Data Collection and Analysis

Surveys were completed by noting humphead wrasse observed during the course of diving for other studies from November 1996 to June 1997. These dives were mostly focused on completing visual censuses of other fish species and lent themselves well to noting the presence of humphead wrasse. The total dive time was noted as well as the number and size of any humphead wrasse observed. Two sites were surveyed by snorkeling (J and K); all other were surveyed on scuba. Five habitat types were identified (Fig. 1): 1) reef slopes on the outside of the atoll rim (sites: a, g, r, t, x, and z, Fig. 1 and Table 1); 2) reef slopes on the inside of the atoll rim (sites: b, c, d, e, f, h, i, j, q, s, v, y, and w); 3) channels that lead from the inside to the outside of the atoll rim (sites: u, A, J, and K); 4) faros (sites: B-H); and 5) shallow (< 2m) reef crest and lagoonal patch reefs (mostly branching acropid patches). Due to only zero values in faro and shallow sites, these two habitats were not used in the analysis.

The number of wrasse observed per hour was plotted by habitat type and tested for significant differences using a Kruskal-Wallis ANOVA. A non-parametric ANOVA was selected due to the highly skewed distribution resulting from numerous zero values. Size was estimated visually after training. Parametric analysis of variance was used to test for significant differences in mean size among the three habitats.

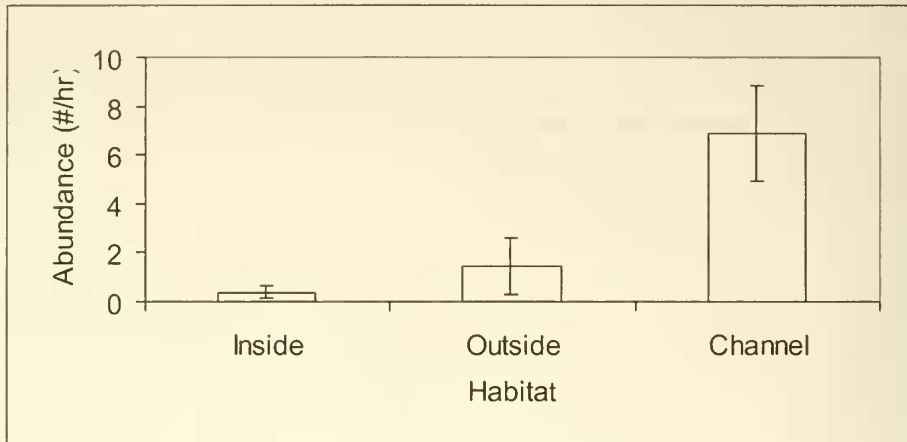
## RESULTS

Thirty-six sites were studied (Table 1) yielding a total of 51 fish observed during 103 hours and 43 minutes of sampling. Humphead wrasse were observed more often in channels than in any other habitat (Fig. 2). The mean number of humphead wrasse per hour of observation was significantly higher in channels than inside atoll-rim reef slopes ( $p < 0.05$ ). Fish occurrence at outside atoll-rim reef slope sites was not significantly different than either those at the inside atoll-rim sites or the channel sites. More

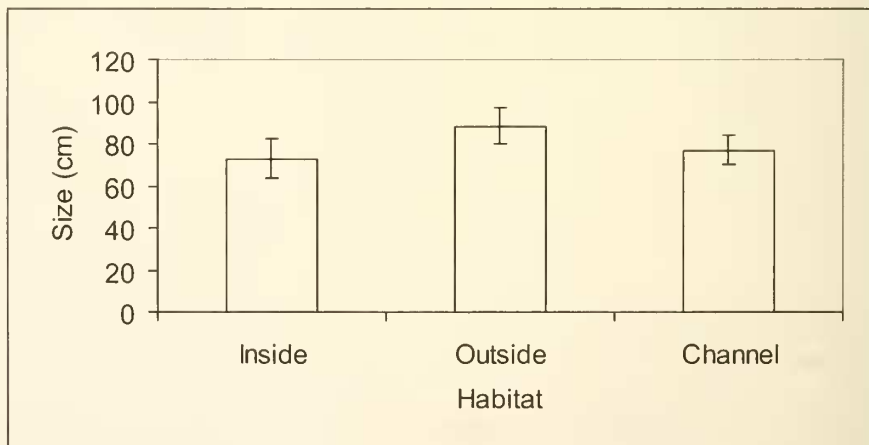
replication would be necessary to ascertain differences between this habitat and the other two as there was high variability in the data. Average size was not significantly different among the three habitat types where this species was observed (Fig. 3,  $p > 0.05$ ). Sizes ranged from 30-140 cm with a mean ( $\pm 1\text{SE}$ ) of 80.2 (4.8) (Fig. 4).

Table 1. Survey sites, including site codes which reference Fig.1. The time surveyed, number of humphead wrasse observed, and average size of individuals are given for each site. The two sites marked with an  $^+$  were surveyed using snorkel; all others by scuba.

Site	Site code	Time surveyed (h:min)	No. observed	Size (cm $\pm$ 1SE)
Gaadhoo outside	a	1:26	10	95 (10)
Gaadhoo inside	b	0:50	2	65 (35)
Fonadhoo	c	0:30	0	
Kadhdhoo	d	0:39	0	
Matimatidhoo	e	6:15	0	
Gamu inside	f	6:14	0	
Gamu outside	g	1:55	0	
Bodufinalhu slope	h	25:24	0	
Bodufinalhu deep	i	1:41	0	
Bodufinalhu shallow	j	11:30	0	
Bodufinalhu lagoon	k	2:00	0	
Bodufinalhu channel	l	2:00	0	
Gaskandufinalhu lagoon	m	1:00	0	
Baresdhoo channel	n	4:00	0	
Bodufinalhu reefcrest	o	3:00	0	
Baresdhoo reefcrest	p	2:30	0	
Baresdhoo inside	q	4:36	1	100 (-)
Baresdhoo outside	r	2:40	0	
Mundo inside	s	1:28	0	
Mundu outside	t	0:50	0	
Mundu channel	u	0:56	9	78 (10)
Maabaidhoo	v	1:46	4	70 (6)
Fushi channel	J	1:00 $^+$	3	93 (7)
Vadinalhoo inside	w	0:59	0	
Vadinalhoo outside	x	1:44	3	65 (9)
Vadinalhoo channel	K	1:00 $^+$	4	65 (13)
Maava inside	y	1:54	0	
Maava outside	z	1:40	0	
Maava channel	A	1:23	15	5 > 100
Gaadhoo faro	B	0:38	0	
Fonadhoo faro	C	2:16	0	
Mundu faro	D	1:21	0	
Baresdhoo faro 1	E	4:36	0	
Baresdhoo faro 2	F	0:20	0	
Vadinalhoo faro	G	2:03	0	
Maava faro	H	1:39	0	



**Figure 2.** Mean humphead wrasse abundance (number/hour  $\pm 1$  SE) among three habitat types: reef slopes inside the atoll rim; reef slopes outside the atoll rim; and channels connecting the inside and outside of the atoll rim.



**Figure 3.** Mean size (cm  $\pm 1$  SE) of humphead wrasse observed among three habitat types: reef slopes inside the atoll rim, reef slopes outside the atoll rim, and channels connecting the inside and outside of the atoll rim.

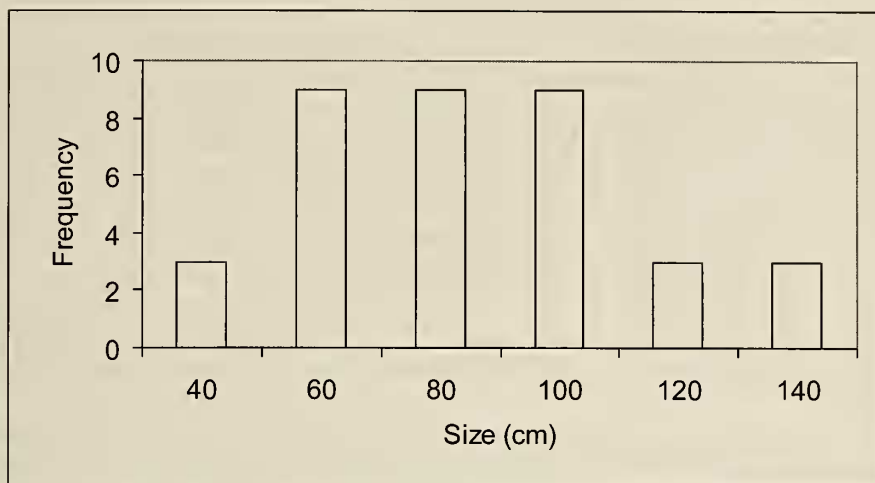


Figure 4. Size-frequency distribution of all humphead wrasse where size data were available ( $n=31$ ).

## DISCUSSION

Humphead wrasse preferentially occupied channel habitats in Laamu Atoll, Maldives. This species was also observed in three reef-slope sites inside the atoll rim and two reef-slope sites outside the atoll rim. However, two of three inside sites and both outside sites were adjacent to channel habitats. Only one humphead wrasse was observed at a site located a significant distance from a channel. It is unknown why this species prefers this type of habitat. Comparative data are only available from one other central Indian Ocean site (Sluka and Lazarus, in press). The relative abundance of this species at the study sites in Maldives (0.49 fish/hr) was approximately three times higher than at sites on the west coast of India (0.18 fish/hr). However, the Indian sites were mainly non-carbonate reefs with high structural complexity but low coral cover (Sluka, Mary, and Lazarus, unpublished data) and thus of a significantly different habitat type.

Little is known about humphead wrasse biology which can be used to infer causative agents of distribution patterns. This species eats a wide range of prey including mollusks, fish, and sea urchins, and the crown-of-thorns starfish, *Acanthaster planci* (Randall et al., 1978). The reef-slope habitats of Laamu Atoll have high coral cover and tend to have high spatial complexity, including vertical relief (R. Sluka and M.W. Miller, unpublished data), while the channels tend to have lower vertical relief and spatial complexity (Sluka, pers. obs.). It may be that food items are easier to find due to the relative lack of hiding places and more exposed nature of the channel coral reefs. However, the humphead wrasse observed in the channels tended to be found near the outer edge of the channel adjacent to the point at which the channel drops off and turns into the reef slope. It is unknown if this species switches ends of the channel with the changing of the tide (i.e., in outgoing tides it is located primarily at the outer end of the channel and in ingoing tides, the inner end). If this were the case, it would seem likely that humphead wrasse were making use of the currents for foraging activity.

Knowledge of habitat preferences of humphead wrasse is important for the management of this species. While a total ban on export is the ideal situation as far as the resource is concerned, some level of exploitation may be possible once the biology and ecology of this species are better known. Where other management strategies need to be used, protection of spawning aggregations within a system of marine fishery reserves appears to be the best strategy for long-term sustained exploitation of long-lived, slow growing coral-reef species (Roberts et al., 1995). Johannes (1980) suggested that protecting spawning aggregations by limiting fishing, either spatially or temporally, could be one of the most effective management strategies. Humphead wrasse have been observed to aggregate in large numbers to spawn (Johannes and Riepen, 1995). By protecting these spawning events, the larger individuals which have higher fecundity than smaller fishes are allowed to reproduce and potentially supply recruits to surrounding areas.

It is clear that there is intense pressure on the humphead wrasse resources of the Indo-Pacific. The Maldivian Government banned the export of humphead wrasse in 1995 owing to concerns of the recreational diving industry. However, effective enforcement of these regulations is lacking as import statistics show that Maldives is still exporting significant quantities of humphead wrasse to Hong Kong (Lau and Parry-Jones, 1999). Until we learn more concerning habitat requirements and population biology of this species, it is unknown what impact this exploitation has on these fishes in this region.

### ACKNOWLEDGEMENTS

This study was conducted while funded by grants from the Research Fellowship Program of the Wildlife Conservation Society, The National Geographic Society's Committee for Research and Exploration, John G. Shedd Aquarium's Aquatic Science Partnership (funded by the Dr. Scholl Foundation), and the Lerner Gray Fund for Marine Research of the American Museum of Natural History. I wish to thank Mr. Yoosuf Nishar and Mr. Abudullah Hakeem who assisted in all aspects of the field work. Mr. Ahmed Shakeel and Ms. Aishath Shaan Shakir of the Oceanographic Society of Maldives provided support throughout the project.

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